

**Radiation Total Dose Test Results:
OP-11ARC Operational Amplifier (Analog Devices)**

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1. Introduction

The OP-11ARC manufactured by Analog Devices was tested for its sensitivity to total ionizing dose radiation. The test was conducted in December 2005.

2. Device Description

The OP11 provides four 741-type operational amplifiers. The amplifiers are matched for common-mode rejection ratio and offset voltage. Device and test information are listed in Table I. The pin-out information is shown in Fig. 1.

Table I.
Device and Test Information

Generic Part Number:	OP-11ARC
Full Part Number	5962-898012A
Manufacturer:	Analog Devices
Lot Date Code (LDC):	0412F
Quantity Tested:	8
Serial Numbers of Control Sample:	1
Serial Numbers of Radiation Samples:	2, 3, 4, 5, 6, 7
Part Function:	Operational Amplifier.
Part Technology:	Bipolar
Package Style:	20-pin surface mount
Test Equipment:	Parametric Analyzer, dual power supply
Test Engineer:	C. Stauffer
Dose Levels (krad (Si))	5,10,15,20,30, 40, 50, 75, 100
Target dose rate (rad (Si)/sec)	0.02
Case Markings	TOP: 2A; 5962-89801012A; 0412F BOTTOM: N07417; PHILLIPINES

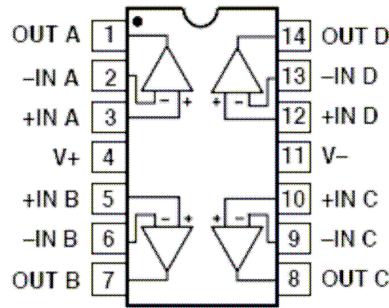


Fig. 1. Pin-out of the OP11.

3. Test Method

Seven devices were tested. Six devices were exposed to gamma rays in the NASA/GSFC Co⁶⁰ cell and one device was used as a control. The devices were exposed under bias with the supply voltages at +/- 15V, the inputs grounded and the outputs floating. Both for testing and for irradiation, the parts were configured as voltage followers. The total dose levels were 0, 5, 10, 15, 20, 30, 40, 50, 75, and 100 krad(Si) and the dose rate was 0.02 rad (Si)/sec. At each dose level the devices were electrically and functionally characterized using a parametric analyzer. Fig. 2 shows the bias configuration.

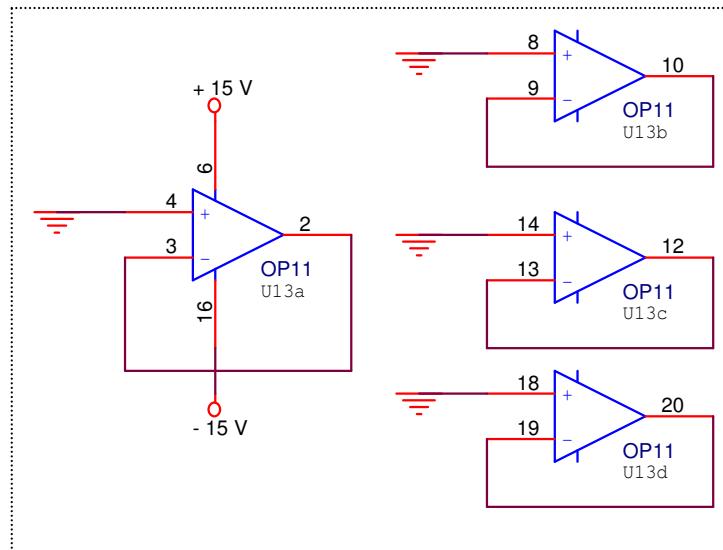


Figure 2. OP-11ARC radiation exposure bias circuit.

4. Results

The results of the radiation testing are shown in the following tables.

Table II
Input Bias Current (A) as a Function of Total Dose

TID	Control	DUT#2	DUT#3	DUT#4	DUT#5	DUT#6	DUT#7	Average	St. Dev.
0	-9.64E-08	-1.01E-07	-1.04E-07	-9.65E-08	-1.05E-07	-1.06E-07	-1.02E-07	-1.02E-07	3.36E-09
5	-9.63E-08	-1.54E-07	-1.88E-07	-1.61E-07	-1.77E-07	-1.86E-07	-1.82E-07	-1.75E-07	1.39E-08
10	-9.66E-08	-2.09E-07	-2.80E-07	-2.35E-07	-2.53E-07	-2.80E-07	-2.72E-07	-2.55E-07	2.87E-08
15	-9.64E-08	-2.75E-07	-3.82E-07	-3.17E-07	-3.30E-07	-3.82E-07	-3.72E-07	-3.43E-07	4.33E-08
20	-9.65E-08	-3.43E-07	-4.96E-07	-4.07E-07	-3.38E-07	-4.84E-07	-4.67E-07	-4.22E-07	7.03E-08
30	-9.68E-08	-4.75E-07	-6.35E-07	-5.58E-07	-3.37E-07	-6.41E-07	-5.59E-07	-5.34E-07	1.14E-07
40	-9.63E-08	-5.71E-07	-6.03E-07	-6.50E-07	-3.34E-07	-6.37E-07	-5.31E-07	-5.55E-07	1.16E-07

Table III
Positive Supply Current (A) as a Function of Total Dose

TID	Control	DUT#2	DUT#3	DUT#4	DUT#5	DUT#6	DUT#7	Average	St. Dev.
0	-9.64E-08	-1.01E-07	-1.04E-07	-9.65E-08	-1.05E-07	-1.06E-07	-1.02E-07	-1.02E-07	3.36E-09
5	-9.63E-08	-1.54E-07	-1.88E-07	-1.61E-07	-1.77E-07	-1.86E-07	-1.82E-07	-1.75E-07	1.39E-08
10	-9.66E-08	-2.09E-07	-2.80E-07	-2.35E-07	-2.53E-07	-2.80E-07	-2.72E-07	-2.55E-07	2.87E-08
15	-9.64E-08	-2.75E-07	-3.82E-07	-3.17E-07	-3.30E-07	-3.82E-07	-3.72E-07	-3.43E-07	4.33E-08
20	-9.65E-08	-3.43E-07	-4.96E-07	-4.07E-07	-3.38E-07	-4.84E-07	-4.67E-07	-4.22E-07	7.03E-08
30	-9.68E-08	-4.75E-07	-6.35E-07	-5.58E-07	-3.37E-07	-6.41E-07	-5.59E-07	-5.34E-07	1.14E-07
40	-9.63E-08	-5.71E-07	-6.03E-07	-6.50E-07	-3.34E-07	-6.37E-07	-5.31E-07	-5.55E-07	1.16E-07

Table IV
Negative Supply Current (A) as a Function of Total Dose

TID	Control	DUT#2	DUT#3	DUT#4	DUT#5	DUT#6	DUT#7	Average	St. Dev.
0	-5.01E-03	-4.81E-03	-4.69E-03	-4.88E-03	-4.76E-03	-4.73E-03	-4.76E-03	-4.77E-03	6.42E-05
5	-2.91E-03	-2.69E-03	-2.57E-03	-2.72E-03	-2.62E-03	-2.59E-03	-2.61E-03	-2.63E-03	5.84E-05
10	-5.01E-03	-4.64E-03	-4.47E-03	-4.68E-03	-4.56E-03	-4.51E-03	-4.54E-03	-4.57E-03	7.89E-05
15	-5.01E-03	-4.56E-03	-4.36E-03	-4.60E-03	-4.48E-03	-4.43E-03	-4.45E-03	-4.48E-03	8.81E-05
20	-5.01E-03	-4.50E-03	-4.34E-03	-4.54E-03	-4.42E-03	-4.38E-03	-4.40E-03	-4.43E-03	7.78E-05
30	-5.01E-03	-4.42E-03	-4.27E-03	-4.47E-03	-4.35E-03	-4.31E-03	-4.33E-03	-4.36E-03	7.41E-05
40	-5.01E-03	-4.38E-03	-4.25E-03	-4.44E-03	-4.32E-03	-4.29E-03	-4.30E-03	-4.33E-03	7.11E-05

Table V
Input Offset Voltage (V) as a Function of Total Dose

TID	Control	DUT#2	DUT#3	DUT#4	DUT#5	DUT#6	DUT#7	Average	St. Dev.
0	-2.90E-04	-2.00E-05	-6.00E-05	-1.60E-04	-3.10E-04	-6.00E-05	-2.40E-04	-1.42E-04	1.15E-04
5	-3.00E-04	-4.00E-05	-8.00E-05	-2.00E-04	-3.40E-04	-9.00E-05	-2.70E-04	-1.70E-04	1.19E-04
10	-2.90E-04	-1.00E-05	-8.00E-05	-1.90E-04	-3.50E-04	-5.00E-05	-2.50E-04	-1.55E-04	1.31E-04
15	-2.80E-04	-1.00E-05	-8.00E-05	-1.90E-04	-4.10E-04	-1.00E-04	-2.70E-04	-1.77E-04	1.46E-04
20	-2.80E-04	-3.00E-05	-1.50E-04	-1.70E-04	-4.20E-04	-1.10E-04	-3.50E-04	-2.05E-04	1.49E-04
30	-2.80E-04	-3.00E-05	-3.90E-04	-2.00E-04	-4.00E-04	-3.70E-04	-5.10E-04	-3.17E-04	1.72E-04
40	-3.00E-04	-7.00E-05	-4.30E-04	-3.00E-04	-4.60E-04	-4.40E-04	-5.00E-04	-3.67E-04	1.60E-04

5. Conclusion

Since the device electrical configuration we used was specifically chosen for the intended application and differed from the configuration used by the manufacturer to generate the data in the data sheet, a direct comparison is not possible.